WIRED SUPPLY FOR AERIAL DRONE IN HARSH ENVIRONMENT

(POWER MANAGEMENT)

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This Thesis is dedicated to

To my beloved parents for their love and support which gives me great inspiration.

To my friends for their motivation and support.

To my lecturers for their guidance and knowledge given for me to be a better student.

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ABSTRACT

A quadcopter is an aerial vehicle that uses four rotors for lift, steering, and stabilization. Unlike other aerial vehicles, the quadcopter can achieve vertical flight in a more stable condition and the use of battery powered unmanned aerial vehicles are quite common among hobby flayers and aerial photographers. But the main problem with battery operated aerial vehicle is its flight time because the commercial unmanned aerial vehicles or in other names is drone has up to 20-40 flight with replaceable dual battery configuration. Each battery takes 100 minutes to recharge. A tethered UAV is capable of solving this issue. This research addresses the power optimization problem of a tethered quadcopter for mini payload or high payload long time hovering. Tethered quadcopters are unmanned aerial vehicles with ability of vertical take-off, landings and hovering at a desired location. In already existing tethered UAV's the power consumption is not optimum due to the lack of proper knowledge about the power parameters like voltage, current and throttle level. So in this thesis will concentrate on findings the optimum value of parameters to be fed to the quadcopters for a particular payload value.

ABSTRAK

Helikopter yang berbilah empat adalah satu kenderaan udara yang menggunakan empat biji motor untuk terbang, stereng, dan penstabilan. Tidak sama dengan kenderaan udara yang lain, helikopter berbilah empat boleh terabng secara menegak, lebih stabil, dan menggunakan bateri adalah salah satu sumber utamanya bagi peminat hobi dan jurugambar udara. Tetapi masalah utamanya adalah bateri kenderaan udara tersebut mempunyai 20 hingga 40 minit masa penerbangan dengan konfigurasi bateri dwi ganti. Setiap bateri akan mengambil masa 100 minit untuk caj semula. Cara menyelesaikan masalah ini adala dengan menggunakan helicopter yang akan disambungkan wayar elektrik yang akan disambungkan kepada helicopter berbilah empat. Kajian ini akan mendedahkan cara pegunnan kuasa bagi mengoptimumkan penggunaan tenaga yang betul mengenai parameter kuasa seperti voltan, arus dan tahap kelajuan helikopter bilah empat tersebut.

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LIST OF ABBREVIATIONS

UAV	-	Unmanned Aerial Vehicles
UGV	-	Unmanned Ground Vehicles
MUAV	-	Micro Unmanned Vehicles
ESC	-	Electronic Stability Control
AC	-	Alternating Current
DC	-	Direct Current
PID	-	Proportional Integral Derivative
GPS	-	Global Positioning System
LiPo	-	Lithium-polymer
PCB	-	Printed Circuit Board
ARES	-	Advanced Routing and Editing Software
ISIS	-	Intelligent Schematic Input System

CHAPTER I

INTRODUCTION

This chapter describes the background of this project and the problems faced in real life of maintenance process to extend the flight time of drone in power management that triggers the idea to develop this project. This chapter includes project background, problem statements, project objectives, project scopes and expected output from this project.

1.1 Background

Unmanned Aerial Vehicles (UAV) or in other name drone is used in many research applications in scientific community. The use of battery powered unmanned aerial vehicles are quite common among hobby flayers and aerial photographers. The main problem with battery operated aerial vehicle is its flight time. A tethered UAV is capable of solving this issue [1].

The world tethered means tied to a rope or more making restricting the movements. A tethered UAV consists of all the basic components a normal UAV needs except an on board power source. Tethered UAV serves as an in the air platform for many applications while the power required for motors to generate lift is supplied by the external power source.

Though the movements of such a UAV are restricted, it can be applied on long endurance required applications such as Surveillance, communication etc. the power supply for such a system is given by a UPS assembly which is capable of varying its output voltage and current depending upon load

Most drones is powered by lithium-polymer batteries (LiPo) which only last for about 20 minutes, depending on your load. Using this as main power sources means that you will have to bring the drone down to replace or recharge the battery quite often[1].

LiPo work on the principle of intercalation and de-intercalation of lithium-ions from a positive electrode material and a negative electrode material, with liquid electrolyte providing a conductive medium, to prevent the electrodes from touching each other directly, a micro porous separator is placed in between, which allows only the ions and not the electrode particles to migrate from one side to another side.

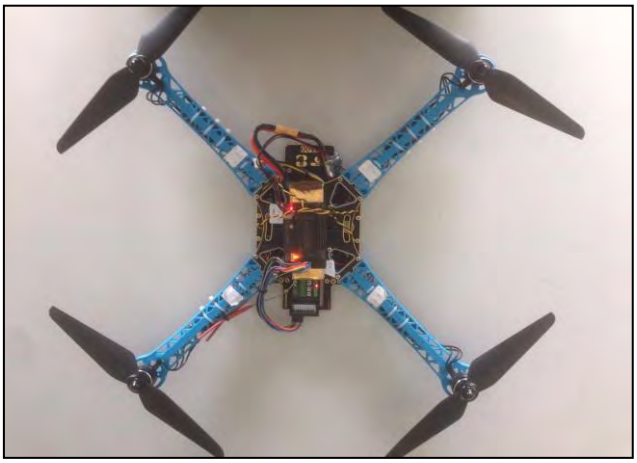

Figure 1.1: Drone with Lithium – Polymer Battery (LiPo)

Figure 1.2: Lithium-Polymer battery (LiPo)

A drone was designed and built using composite materials and aluminium rods. Designing and fabrication stages were carefully planned so as to reduce weight of frame which is the primary method to reduce power consumption.

Once the basic structure is ready, all avionic components which comprises of flight controller, GPS module, Motor and ESC are mounted. All power and communications links were established and verified. A 20 meter cable is used to power the drone from ground supply.

The ground supply is selected according to the voltage requirements of the system. The supply system is capable of varying voltage level with necessary current output. In order to measure the power consumption a watt meter, with matching configuration has been used [2].

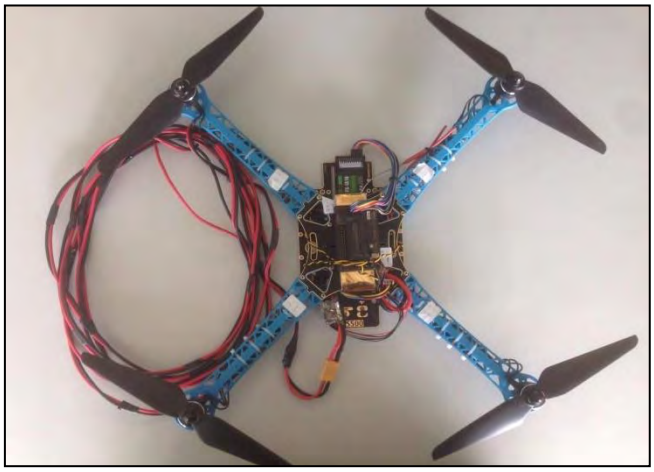

Figure 1.3: Drone tethered

One of the issues when using drones is that crashes can occur due to technical to human. When using a tethered drone many of those issues will be resolved such as piloting errors. By having the drone tethered to an object. Its movement will automatically be restricted and eliminates the need for a trained pilot to operate it the same concept applies to technical errors too.

With the chances of crashes decreased and piloting skills kept to a minimum, the odds of having an accident are considerably smaller. Of course, safety is not the only thing tethered drone have to offer.

1.2 Problem Statement

Currently the commercial drone has up to 20-40 minute flight with replaceable dual battery configuration. Each battery takes 100 minutes to recharge. Batteries are ineffective and inefficient for long flight. If drones were not limited to this short flight time, it could be used as temporary structures. For example, drones with unlimited flight can fly and supply data service acting as a temporary cell tower without having to build structure. For these reasons, unlimited hover would allow drones to perform tasks that were previously impossible.

To provide enough constant power for the unlimited drone flight, a powered wire (tether) must be attached to the drone. The tether must be long enough for the drone to fly 100 feet in the air.

1.3 Objective

The objective of this thesis is as follow:

1. To design and develop power delivery system by using extended wired to make the drone flying at a certain height.

1.4 Scopes

Development of this **wired supply for aerial drone in harsh environment (power management)** is divided into two working scope which is software and hardware integration. The first scope is converting the power supply from AC to DC. Trying to convert from AC to DC power using three phases to single phase concept and Proteus software is used for the design the circuit for measurement the output the current and maintain the voltage.

Second scope is hardware development. This hardware development started just after the first scope successfully had been simulated to ensure sufficient power for the drone with length of tether cable and the height it will fly around 100 feet or more.

- Convert the power supply from AC to DC
- To ensure sufficient power for the drone with length of tether cable and the height it will fly around 100 feet or more.

1.5 Research Interest

The interest of this project is about acquiring knowledge in developing an electronic circuit and knowledge in powering system. With the right information, each of the function of the components used in this project can be detail studied and applied. A part from that, the installation process of the electronic component such as placing the components with the right poles, value and type also can be learn.

Student also can gain an enormous experience when completing this project. There is so much process and step needed to be done in order to achieve to stable and working electronic devices. All knowledge that has been learned on the previous bachelor studies surely would be used for completing this project including the basic and important one which is determining the resistor values, designing a simulation system, designing the printed circuit board, fabricating the printed circuit board and also soldering the electronic component.

New ideas or knowledge that cannot be learnt in classes is obtained when student face a problem while developing the circuit. Troubleshooting process is needed in order to make sure the device is completely working. An experience of developing a full complete electronic device is a very useful experience and cannot be learnt in a short time, student must face the hard moment before they can gain a whole new valuable experiences.

1.6 Thesis Structure

This bachelor project report contains five chapters for explaining about the development of the **wired supply for aerial drone in harsh environment (power management).** This report starts with introduction, literature studies, methodology, results and discussion, conclusion and suggestion

The first chapter briefly describes the background and overview about the conducted research work. Besides that, this chapter also covers problem statement, objectives and the scopes of the research work.

The second chapter covers important literature review related to the research work and this chapter contain the literature studies of the theoretical concept that applied on this project. It also contain the information obtain or completing the project.

This third chapter is about the methodology of the way the project is carried out. In this chapter, step-by-step, methods and process flow are shown in details to carry out tasks described in research scope.

The forth chapter is results and discussions. In this chapter will be analysing the base on the given scope. Discussion about the constraint while conducting this project. The tabulated graph will be discussed in this part to compare the performance of the material used in this project. The theory and the practical part will be compared to ensure similarities while conducting the project along the way. The ways of improvements will be discussed in the following chapter.

The last chapter of this thesis is chapter 5. In this part is all about of this project that includes project survey, achievement in analysing data and concludes the overall achievement of this project. Future work also will be discussed in this project so that improvement can be made to sustain a better quality of project

CHAPTER 2

LITERATURE REVIEW

This chapter reviews previous research and studies to obtain ideas and information related to the project that will be developed. Based on review of the research article and studies it aided the progress of the project in order to designing the methodology to meet the best solution for the problem that should be done efficiency in short period of time.

2.1 Previous Power Management Studies and Projects

This section will discuss about the system that has been created before this. This information has been studied prudently in order to enhance the quality and reliability of this project. By analysing the ideas and recommendation of previous project, a lot of information is obtained and can be used as a references or guidance for completing this project. By studying the preceding works, a proper thing or design is considered in order to make this project become reliable and marketable. In addition to that, there are little findings from internet and books that are extremely contribute to this project.

2.2 An Approach for Power Optimization of Tethering UAV

This project is inspired by research work done in [1]. This research paper addresses the power optimization problem of tethered quadcopter for mini payload long time hovering is expected. Besides that, the tethered quadcopter are unmanned aerial vehicles with ability of vertical take offs, landings and hovering at a desired location. Since the vehicles is tethered, it has no flight time restrictions that the battery operated unmanned aerial vehicle has and so suitable for long time uninterrupted applications.

In already existing tethered UAV's the power consumption is not optimum due to the lack of proper knowledge about the power parameters like voltage, current and throttle level. So they concentrated on findings the optimum value of parameters to be fed the quadcopter for a particular payload value.

In this research also they discussed the power consumption varies according to the stages of flight and they said after the throttle reaching 60% there is no change in altitude or power consumed. This is because of the insufficient input voltage.